
Batni motorji z notranjim zgorevanjem - Varnostne zahteve za načrtovanje in konstruiranje motorjev za uporabo v potencialno eksplozivnih atmosferah - 2. del: Motorji skupine I za uporabo v podzemnih deloviščih, ki jih ogroža jamski eksplozivni plin in/ali vnetljiv prah

Reciprocating internal combustion engines - Safety requirements for design and construction of engines for use in potentially explosive atmospheres - Part 2: Group I engines for use in underground workings susceptible to firedamp and/or combustible dust

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Hubkolben-Verbrennungsmotoren - Sicherheitsanforderungen für die Konstruktion und den Bau von Motoren zur Verwendung in explosionsgefährdeten Bereichen - Teil 2: Motoren der Gruppe I zur Verwendung in untertägigen Bergwerken, die durch Grubengas und/oder brennbare Stäube gefährdet werden können

Moteurs alternatifs a combustion interne - Prescriptions de sécurité pour la conception et la construction des moteurs fonctionnant en atmosphere explosible - Partie 2: Moteurs du groupe I utilisés dans des travaux souterrains dans des atmospheres grisouteuses avec ou sans poussieres inflammables

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EUROPEAN STANDARD
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Reciprocating internal combustion engines - Safety requirements for design and construction of engines for use in potentially explosive atmospheres - Part 2: Group I engines for use in underground workings susceptible to firedamp and/or combustible dust

Moteurs alternatifs à combustion interne - Prescriptions de sécurité pour la conception et la construction des moteurs fonctionnant en atmosphère explosible - Partie 2: Moteurs du groupe I utilisés dans des travaux souterrains dans des atmosphères grisouteuses avec ou sans poussières inflammables

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This European Standard was approved by CEN on 8 July 1999.

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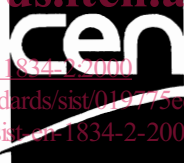
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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Central Secretariat: rue de Stassart, 36 B-1050 Brussels

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Foreword

This European Standard has been prepared by Technical Committee CEN/TC 270 "Internal combustion engines", the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by July 2000, and conflicting national standards shall be withdrawn at the latest by July 2000.

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this standard.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Normative and informative annexes to this standard are indicated in the contents list. General Safety requirements for Internal Combustion Engines are given in EN 1679-1:1998.

0 Introduction

This European standard has been prepared to be a harmonised standard to provide one means of conforming with the essential safety requirements of the Machinery (98/37/EEC) and ATEX (94/9/EEC) Directives and associated EFTA regulations.

This European Standard is a type C standard as defined in EN 292:1991.

The extent to which hazards are covered is indicated in the scope of this standard. In addition, machinery shall comply as appropriate with parts 1 and 2 of EN 292:1991 for hazards which are not covered by this standard.

The requirements of this standard apply to designers, manufacturers, suppliers and importers of reciprocating internal combustion engines.

This standard also contains the information to be provided by the manufacturer of reciprocating internal combustion engines to the user.

1 Scope

This European standard specifies the safety requirements and/or measures to remove the hazards and limit the risks on reciprocating internal combustion compression ignition engines of group I category M 2 for use in underground workings susceptible to firedamp and/or combustible dust hereinafter referred to as engines.

The standard does not define requirements relating to the driven machinery. These requirements can be found in the appropriate application standard.

This standard does not apply to engines of category M 1 which require special considerations. This standard does not apply to engines used in premises for the processing, manufacture or storage of explosives.

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The safety requirements for engines for use in flammable gas and vapour atmospheres are given in EN 1834-1:2000.

The safety requirements for engines for use in explosive atmospheres with combustible dust are given in EN 1834-3:2000.

This standard does not apply to spark ignition engines.

The hazards applicable are listed in 4 and relate to the additional hazards of operation in an atmosphere that may become explosive. The tests which the engine and its ancillary fittings are required to undergo to verify compliance with this specification are detailed in this standard. General safety requirements i.e. those common to all the RIC engines, are covered in EN 1679-1:1998.

This European standard is applicable to engines which are manufactured after the date of issue of this standard.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 292-1	1991	Safety of machinery - Basic concepts, general principles for design - Part 1: Basic terminology, methodology
EN 292-2:1991/+A1:1995		Safety of machinery - Basic concepts, general principles for design - Part 2: Technical principles and specifications
EN 1050	1996	Safety of machinery – Principles for risk assessment
EN 1127-1	1997	Explosive atmospheres – Explosion, prevention and protection – Part 1: Basic concepts and methodology
EN 1679-1	1998	Reciprocating internal combustion engines - Safety - Part 1: Compression ignition engines
EN 1834-1	2000	Reciprocating internal combustion engines - Safety requirements for design and construction of engines for use in potentially explosive atmospheres - Part 1: Group II engines for use in flammable gas and vapour atmospheres
EN 1834-3	2000	Reciprocating internal combustion engines - Safety requirements for design and construction of engines for use in potentially explosive atmospheres - Part 3: Group II engines for use in flammable dust atmospheres
EN 50014	1997	Electrical apparatus for potentially explosive atmospheres – General requirements
EN 50015	1994	Electrical apparatus for potentially explosive atmospheres – Oil immersion "o"

EN 50016	1995	Electrical apparatus for potentially explosive atmospheres - Pressurised apparatus "p"
EN 50017	1994	Electrical apparatus for potentially explosive atmospheres - Powder filling "q"
EN 50018	1994	Electrical apparatus for potentially explosive atmospheres - Flameproof enclosures "d"
EN 50019	1994	Electrical apparatus for potentially explosive atmospheres - Increased safety "e"
EN 50020	1994	Electrical apparatus for potentially explosive atmospheres - Intrinsic safety "i"
EN 50028	1987	Electrical apparatus for potentially explosive atmospheres - Encapsulation "m"
EN 50039	1980	Electrical apparatus for potentially explosive atmospheres - Intrinsic safety systems "i"
ISO 1813	1979	Antistatic endless V belts - Electrical conductivity - Characteristics and method of test
ISO 2710	1978	Reciprocating internal combustion engines - Vocabulary
ISO 3046-3	1989	Reciprocating internal combustion engines - Performance - Part 3: Test measurements
ISO 7967-1	1987	Reciprocating internal combustion engines - Vocabulary of components and systems - Part 1: Structure and external covers
ISO 7967-2	1987	Reciprocating internal combustion engines - Vocabulary of components and systems - Part 2: Main running gear
ISO 7967-3	1987	Reciprocating internal combustion engines - Vocabulary of components and systems - Part 3: Valves, camshaft drive and actuating mechanisms
ISO 7967-4	1988	Reciprocating internal combustion engines - Vocabulary of components and systems - Part 4: Pressure charging and air/exhaust gas ducting systems
ISO 7967-8	1994	Reciprocating internal combustion engines - Vocabulary of components and systems - Part 8: Starting systems
ISO 9563	1990	Belt drives - Electrical conductivity of antistatic endless synchronous belts - Characteristics and test method

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3 Definitions

For the purposes of this standard, the definitions in ISO 2710:1978 and ISO 7967-1:1987, ISO 7967-2:1987, ISO 7967-3:1987, ISO 7967-4:1988 and ISO 7967-8:1994 and the following definitions apply:

3.1 Explosive atmosphere: a mixture with air under atmospheric conditions of combustible material in the form of fire damp and/or combustible dust in which, after ignition, combustion spreads throughout the unconsumed mixture.

3.2 Potentially explosive atmosphere: an atmosphere which could become explosive due to local and operational conditions.

3.3 Categories:

Categories M 1 and M 2 for equipment group I are defined in the ATEX directive (94/9 EC).

In the meaning of ATEX directive, RIC engines are equipments.

3.4 Temperatures

3.4.1 Ignition temperature of an explosive atmosphere

See 3.28, 3.29 and 3.30 of EN 1127-1:1997.

3.4.2 Maximum surface temperature

The highest temperature attained under the most adverse operating conditions of the external surfaces to which the surrounding atmosphere has access. This includes, the engine, its fittings, its ancilliary equipments including flameproof enclosure, flame arrester, spark arrester, ducts, etc.

3.4.3 Maximum temperature

The maximum temperature is the greatest under the most adverse operating conditions of:

- a) the maximum surface temperature as defined in 3.4.2 ;
- b) the maximum temperature of:

- the exhaust gas emitted into the atmosphere immediately after the flame arrester,
- the charge air at the outlet of the boosting device.

3.5 Flameproof enclosure

A gas permeable enclosure which can withstand the pressure developed during an internal explosion and which prevents the ignition of the surrounding atmosphere.

3.6 Flame arrester

A device fitted to the opening of an enclosure or to the connecting pipe work of a system of enclosures to permit the transmission of a gas/air mixture but to prevent the passage of a flame.

A flame arrester consists of the flame arrester element and the flame arrester housing.

3.7 Joints

3.7.1 Closed joints

Any assembly between two parts without an open path leading to the surrounding atmosphere.

3.7.2 Open joints

Any continuous open path through a joint or opening excluding flame arrester (example: valve guide).

4 List of hazards

Only the specific hazards for engine applications in potentially explosive atmospheres are listed below according to EN 1050:1996.

For general hazards see EN 1679-1:1998.

- Hazards generated by materials and substances processed, used, ejected or exhausted by machinery including fire or explosion hazards (see 5.4, 5.10, 5.11) ;
- Hazards caused by failure or malfunction of the control system (see 5.15) ;
- Hazards caused by incorrect position or absence of guards or safety related devices including starting and stopping devices also including safety signs and signals, warning devices or information (see 5.5, 5.6, 5.7, 5.8, 5.9).

The main sources of ignition are:

- Hot surfaces,
- Flames and hot gases,
- Mechanically generated sparks,
- Electrical apparatus and systems,
- Static electricity.

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The potential sources of ignition likely to ignite the surrounding explosive atmosphere are listed in annex A.2.

The design specifications for the engine necessary to minimise the likelihood of an ignition depend on the application and are characterised by:

- temperature classification,
- presence of combustible dust,
- presence of gases other than firedamp.

5 Safety requirements and/or measures

5.1 General

Engines of group I shall meet the requirements of EN 1679-1:1999.

No ignition of the explosive atmosphere outside the flameproof enclosure by hot surfaces, hot gases, flames, sparks or electrical apparatus shall occur.

If there is another gas besides firedamp in the underground workings the engine shall comply in addition with 5.1, 5.2, 5.3 and 5.14 of EN 1834-1:2000.

For category M 2 engines, normal operating conditions and reasonably foreseeable malfunctions shall be taken into account. Rare malfunctions and catastrophic failures need not be considered (see annex A.1.1, A.1.2, A.1.3).

5.2 Maximum temperature

The maximum temperature as defined in 3.4.3 shall, under all operating conditions not exceed 150 °C.

For underground workings without combustible dust this maximum temperature shall not exceed 450 °C.

5.3 Engine designation

Internal combustion engines for use in underground workings susceptible to firedamp and/or combustible dust shall be designated by:

- engine group I,
- the category (M 2),
- the temperature given in 5.2.

5.4 Flameproof enclosure

The flameproof enclosure shall be designed in accordance with gas group I defined in EN 50014:1997.

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The flame proof enclosure shall withstand:

- the pressure of an internal explosion when tested according to 6.3.2 ;
- the overpressure when tested according to 6.3.3 and prevent ;
- transmission of an internal explosion when tested according to 6.3.4.

The number of mechanical connections in the flameproof enclosure shall be minimised.

Each connection of mechanical parts within the flameproof enclosure shall be either a closed joint or an open joint.

Any open joint in the flameproof enclosure leading to the surrounding atmosphere shall be within the ratio of length versus gap shown in EN 50018:1994 for gas group I.

Threaded closed joints shall be designed in accordance with table 5 of EN 50018:1994.

5.5 Air intake system

The air intake system is always considered to take air from a hazardous area.

Each air inlet duct shall be fitted with a flame arrester complying with 5.8 and air shut off valve (see 5.15).

The part of the air intake system between the flame arrester and the engine shall comply with 5.4.

5.6 Exhaust system

The exhaust system is always considered to discharge into a hazardous area.

Each exhaust system shall be fitted with a flame arrester complying with 5.8 and a spark arrester complying with 5.9.

- The part of the exhaust system between the flame arrester and the engine shall comply with 5.4 ;
- The spark arrester shall be located between the flame arrester and the atmosphere ;
- If a type tested spark arrester is used the characteristics of the engine (gas flow, swept volume, gas temperature) and the installation shall be the same as those of the engine used for the type test of the spark arrester.

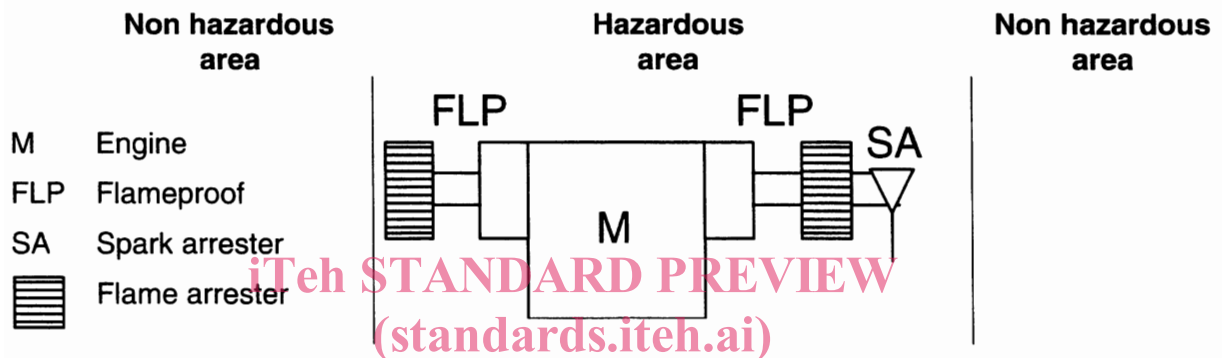


Figure 1

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5.7 Other devices

5.7.1 Cold start devices

If a cold start fluid device is provided, it shall be permanently installed, close to the cylinder head, down stream of the flame arrester. The inlet flame arrester shall be chosen in accordance with the fluid used.

The length and bore dimensions of the injector shall be designed in accordance with 5.4 and shall be tested with the inlet system according to 6.3.

The injection system shall be mechanically protected to withstand the impact test defined in EN 50014:1997 (high risk) without leakage.

5.7.2 Air preheating devices

If air pre-heating devices are provided (such as electric glow plugs, electric grid heaters and pilot flame heaters) they shall be permanently installed downstream of any inlet flame arrester.

5.7.3 Valves and venting devices

Any valve and any venting device which gives direct access to the surrounding atmosphere shall fulfil the following requirement:

The discharge from these valves or venting devices shall either be vented into the flameproof enclosure between the inlet or the exhaust flame arresters and the engine, or be equipped with a flame arrester, conforming to 5.8.

5.7.4 Inlet air pressure boosting devices

Where an air inlet pressure boosting device is provided, it shall be selected such that temperature and pressure within the air inlet pressure boosting device do not produce ignition conditions (see 5.4 and 5.9) and it shall be fitted with an air filter to ensure that no foreign bodies can penetrate inside the air inlet pressure boosting device.

Alternatively the air inlet pressure boosting device shall be part of the flameproof enclosure and tested according to 6.3.

5.7.5 Reverse running

The engine shall be so designed that reverse running of the engine is not possible except for reversible engines.

5.7.6 Fuel systems

See 7.4.